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THE STORY OF A PEARL.

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(Plate I.)

Few subjects in natural history have had so much attention devoted to them both by the popular, and, it may be, poetic writer, and by men of science, as the subject of this paper. Used as pearls were from very early times, and therefore by uncivilized races, as ornaments, their innate beauty and peculiar fitness for decoration made them popular. Thus they were utilized by the Hebrews, the Egyptians, the Ethiopians, the Medes, the Persians, the Greeks, and the Romans; whilst their precious nature was described by the Chinese nearly 2000 years before Christ. Even the forgotten races of the Mississippi valley diligently collected and employed the fresh-water pearls of that region in a remarkable way, for in some of the mounds they are found not by hundreds and thousands, but by bushels, and in some cases are studded thickly on the garments enveloping their dead.*

The earlier writers, such as Pliny and Dioscorides, attributed a fanciful origin to pearls, *viz.* that they arose from drops of dew, or, as others more poetically termed them, "tears of the Nereids." Columbus, therefore, on discovering the coast of Paria,[*] thought he had fallen on the right place for pearls, as the trees grew with their roots in the sea, and these roots were covered with Oysters ready to receive dewdrops from the leaves above them. Ælian, on the other hand, thought they were formed by a flash of lightning in the open shells. Even now there are differences of opinion as to their origin, some (after Rondelet) considering they arise from a diseased condition of the shell-fish, such, for instance, as produces gall-stones or other morbid deposits; others, after Réaumur (and Profs. H. Merkel,[†] Möbius, and Grand,[‡] who followed him), to an abnormal concretion, or an abundant secretion of the nacreous material; to the entrance of a grain of sand (Stenone, Redi, and Count de Bournon, followed by De Blainville[§]); or calcareous crystals, organic *débris*, and amorphous bodies between the shell and the mantle; to the irritation caused by a parasite (De Filippi, *Distoma duplicatum*, and other forms in fresh-water pearls; Küchenmeister, water-mite—De Filippi comparing them with galls); by an egg of the Mussel itself (Sir E. Home[||]), or that of a parasite. Küchenmeister found cysts enclosing larvæ of *Atax* (a mite) in *M. margaritana*; Möbius, remains of Trematodes in pearls from the same species; Kelaart[¶] showed the importance of parasites in such formations in *M. vulgaris*, a view confirmed by Thurston; and Garner[**] observed that the pearls in the Common Mussel were due to Distomids. The same opinion was advanced by Comba, Giard, and quite recently (1901) by Dubois. The view that they are allied to sedimentary concretions, again, was brought forward by Dr. George Harley,[††] who thought them similar in structure to mineral nodules of wavel-

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* G. F. Kunz, 'Brief History of Gathering Freshwater Pearls in the United States.' Bullet. U.S. Fish. Com. vol. xvii. pp. 321–330, 1898.

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[*] P. L. Simmonds, 'Commercial Products of the Sea.' London, 1879, p. 421. Much interesting information will be found in this work.

[†] "Mikrogeologie" in 'Froriep's Notizen,' 1857, i. Bd. no. 2, p. 18.

[‡] "Méthode de cult. de l'Huître Perlière," 'Rev. Marit. et Colon. Ann.' 1895.

[§] 'Dict. Sc. Nat.' vol. xxviii. p. 505.

[||] 'Philos. Trans.' 1826.

[¶] 'Ann. Nat. Hist.' third ser. i. p. 81.

[**] 'Proc. Linn. Soc., Zool.,' xi. p. 426, 1871.

[††] 'Proceed. R. S.' xlv. p. 613.

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lite and to balls of iron pyrites, as well as to gall-stones and calculi of carbonate of lime. Dr. Lyster Jameson[*] has recently revived the opinion of De Filippi,[†] *viz.* that they are caused by parasites.

Linnæus, Chemnitz, and Olivi knew that pearls of a kind could be produced by perforating the valves of the Pearl-Mussels. The former, indeed, thus thought he could produce pearls at will, and, it is said, offered to publish his secret for the benefit of the State. Bouchon-Brandely, who specially studied the French shell-beds in the Tuamotu group of isles, likewise bored the large Pearl-Oysters (Pintadines), fixing the rounded piece introduced as a nucleus by a wooden pin. It was covered by a nacreous layer in four weeks.[‡]

Pearls are found in many shell-fishes, not only in bivalves, where they are best known, but in univalves. Amongst bivalves, they have been found in the Common Oyster (Poli procured a pearl near the heart), *Pinna nobilis*[§] (brown, black, or red pearls), *Spondylus gœderopus* (greenish and pale rose-coloured pearls), *Anomia cepa* (purple pearl), and *Placuna placenta* (the Tamblegam Pearl-Oyster, also called Chinese glass or window Oyster, the shell of which is valuable). Audouin, in 1828, found a minute one of a fine white colour, but not iridescent, in Solen.

Amongst univalves, pearls occur in *Strombus* ('Conch,' of the West Indies), and of a pretty pink colour; *Turbinella* (chank-shell), pale red pearls; two species of *Turbo;* in *Haliotis*, and others.

The majority of the valuable marine pearls are procured from the various species of *Margaritifera* (Pearl-Oyster), and especially from the Ceylonese Pearl-Oyster (*M. vulgaris*), a species extensively distributed off Ceylon, Southern India, the Maldive Islands, in the Persian Gulf, the Red Sea, Malay Peninsula and Archipelago, Australia, New Zealand, New Guinea, Japan, and East Africa. Moreover, since the completion of the Suez Canal, it has increased, like the Sharks, in the Mediterranean, though it has to be remembered that it was formerly known in the eastern part of that sea and off Morocco.* Besides the foregoing, pearl fisheries are also carried on in the Gulf of Mexico, various contiguous islands, in Panama, and California. The true Pearl-Oyster (*M. vulgaris*) is a comparatively small species, but has a beautiful pearly lustre. Like the larger pearl-shells, it is fixed by a byssus or beard (as in the Common Mussel), whereas the Tamblegam Oyster (*Placuna*) has none.

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[*] 'Proceed. Zool. Soc.' March 4th, 1902.

[†] "Sull' Origine delle Perle," 'Est. dal Cimento,' fasc. iv. Torino, 1852.

[‡] 'Rapport, Pêche et la Culture des Huîtres Perlières.' Paris, 1885. *Vide* also 'Perles et Pintadines,' par M. Picquenot. Tahiti, November, 1903.

[§] Prof. Herdman found the same form of *Tetrarhynchus* larva in this as in the Pearl-Oyster.

In addition, two other forms of Oyster are conspicuous in Australian waters, *viz.* the "black lip" and the "silver or gold lip," and both produce pearls, whilst they are valuable in other respects. The latter shell reaches nearly a foot in diameter, and may weigh ten pounds. A third Australian form is the "Shark's Bay" shell.†

Similar Pearl-Oysters are found at the Cape, West Indies, and both sides of Central America.‡ In some of these the pearls (e. g. *M. cetra*, Reeves) are valuable, whilst the shell is less so, the reverse being the case in others. Moreover, S. Grand§ is of opinion that in shallow water the shells are small, but pearls more frequent; whilst in deep water the shells are more valuable, but the pearls fewer.

In our own seas the pearl-producing species are few in number, and their pearls of little value. One of these occurs in vast numbers *viz.* the Common Mussel, whilst the larger Horse-Mussel is not uncommon in deeper water. The great majority of the pearls in the former are white or dull white, a few being bluish or mauve, and some blackish blue. In the Horse-Mussel they often have a nacreous lustre, and may be fixed like tears to the valves.

On the other hand, two forms, viz. *Margaritana* and *Anodonta*, have long been known in the fresh waters of Britain and of Europe for the beauty of their pearls, and the vast variety and great numbers of the *Unios* of American fresh waters have a similar distinction.

Formation of Pearls.—One feature all pearls have in common,

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* M. Raoul Postel (quoted by M. Grand).

† Fine examples of these have been presented to the Museum of the University by Mr. J. R. Josh, M.A., B.Sc.

‡ Fisheries for these go on from July till October.

§ *Op. cit.*

viz. their origin from the cells of the mantle, the soft outer layer or envelopment of the shell-fish, and the structure which secretes the shell itself. The latter is composed of three layers—an outer chitinous or horny layer (periostracum), a calcareous middle or prismatic layer, and a calcareous inner or nacreous layer. The middle layer is formed of prisms in vertical section, and in horizontal section the areas are hexagonal or polygonal. It is chiefly composed of calcium carbonate and calcium phosphate. The inner or nacreous layer is similar in chemical composition, and consists of thin layers or plates of the secretion, which, as the illustrious Sir David Brewster showed, are so arranged as to cause interference with the rays of light, and thus give rise to the iridescent pearly lustre of the surface. Recent observers, such as Biedermann, insist that the calcareous substance of the shell can only be deposited on the organic basis (conchyolin), which will be alluded to subsequently, and the same holds with regard to pearls. Indeed, some, such as Möbius, consider that a pearl represents the shell with its coats reversed—having in the centre the nucleus, then the periostracum (horny layer)—outside which is the layer of hexagonal prisms, whilst externally is the nacreous layer. Such a view, however, is not, as a rule, in accordance with the structure.

The most recent observer, Dr. Lyster Jameson, following De Filippi, Garner, and others, holds that pearls are due to the presence of a minute parasite, which, in the case of the Common Mussel—a species he has worked out most minutely—is a fluke or Distomid of the subgenus *Leucithodendrium* (Loos), and very closely resembling *L. somateriæ* (Levinsen), which occurs in the mature condition in the intestine of the Eider-Duck. Like many other flukes—for example, that which causes the well-known liver-rot in Sheep—the life-history of the Distomid of the Mussel is complex. So far as is known at present, it occurs in its adult condition in the intestine of the Eider-Duck and Scoter (*Œdemia nigra*), both of which feed on Mussels. The eggs from these give rise to young forms (larvæ, but whether by free-swimming *Miracidium* forms is unknown). Jameson thinks the eggs are carried by currents into the mouth of a common shell-fish (*Tapes decussatus*), hatch out in the alimentary canal, enter the circulatory system, and reach the course of the posterior pallial artery. There—that is, in the mantle—they form sporocysts. The same occurs in the Cockle, only they are found along the anterior pallial artery. Within the sporocysts cercariæ are developed, with a pair of eye-spots, but without the appendage or tail so often seen in such forms. These minute parasites escape from the sporocysts, and probably by currents or by creeping find their way into the Mussels between the mantle and the shell. After creeping about on the inner surface of the shell (Jameson) they come to rest, assuming a spherical form, and are visible to the naked eye as little yellowish spots in the connective-tissue of the mantle. By and by the tissues of the host give rise to an investment of epithelium (simple columnar), which ultimately becomes the sac of the pearl (Jameson). The parasite may migrate from its original site, and thus form a double pearl or even three. In any case, the presence of this parasite acts specifically on the Mussel, and the sac around the Distomid soon secretes conchyolin, followed by the pearly substance, "and from this point the growth of the pearl probably takes place on the same lines and at the same rate as the thickening of the shell" (Jameson). The latter author points out that other parasites are not surrounded by such a sac of proliferating cells. If the larva dies, its tissues become a structureless mass, which retains the form of the parasite owing to the rigid cuticle. Calcification occurs in many cases in the tissues of the parasite before it is surrounded by the sac. Whether in any the sac is formed by an infolding of the surface of the mantle has yet to be determined.

For the completion of the life-cycle of the parasite it is necessary that either the Eider-Duck or the Common Scoter should eat the Mussels before the parasite is enclosed by the secretions of the mantle. Like Kelaart, Dr. Jameson broaches the idea of infecting the molluscs with pearl-producing parasites, just as Antonio Villa* did in relation to De Filippi's discovery.

If the origin of the Ceylonese, Australian, and other pearls is similar to those of the Common Mussel, the final hosts will probably be found in fishes which prey on the shell-fishes, such as the Great Ray, with a powerful dental apparatus, mentioned by Holdsworth, at Ceylon; the two fishes with strong jaws alluded to by Bouchon-Brandely at Tuamotu; or *Balistes*, which also eats the Pearl-Oysters; or in a combination of them.

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* "Sull' Origine delle Perle, e sulla possibilità di producte artificialmente," 'Est. dal Politecnico,' fasc. xlviii., Giugno, 1860. Milano.

In shape pearls vary greatly. They are round, oblong, pear-shaped, kidney-shaped, drop-like, biconvex (Möbius's* pearl, which has a darker brownish-green middle mass), slightly dumb-bell-shaped, and of various irregular outlines. In colour they are white, grey, black, lilac, roseate, blue, brown, or reddish brown, and some are fancifully termed golden (S. Grand).

Whilst it may be stated generally that they are formed of layer upon layer of the iridescent nacreous secretion, yet they diverge much in appearance and structure. Thus, in a section of a decalcified pearl from the Common Mussel (Plate I., fig. 4), the field is only marked by the concentric rings of conchyolin, which are more distinct in stained preparations, and which encircle the nucleus, or it may be nuclei. The rings vary in breadth, sometimes being proportionally broad round the nucleus, sometimes narrow. Only in certain examples is a very minute reticulation apparent, and it seems to be different in character from that of the succeeding form. On the other hand, a section of a pearl from the Mussel (*Margaritana*) of the Tay (Plate I., fig. 2) presents over the entire surface a series of bold reticulations with striated walls, from the prismatic condition of the structure, whilst the concentric lines are less conspicuous. Moreover, in certain decalcified sections (Plate I., fig. 3) the radii of conchyolin are in great strength, and form a complex and beautiful series, bound at short intervals by the concentric bands. The same pearl, indeed, may present both appearances in different parts, according to the line of section. The same structure is observed in a section of either kind of pearl without decalcification (Plate I., fig. 1).

As in the Common Mussel, the pearl of the Mussel from the Tay is surrounded by a sheath of epithelium of considerable thickness (Plate I., fig. 5), and it is supported by connective-tissue and muscular fibres. At some period the sheath of the pearl becomes continuous with the outer cellular layer of the mantle, though the origin of the sheath may be independent.

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* 'Sitzungs-bericht d. Gesell. Nat. Freunde zu Berlin,' 10 Jan. 1902, No. 1, p. 1.

Imperfect pearls are formed by inserting foreign bodies between the mantle and the shell, as in the case of the Chinese forms in the fresh-water *Dipsas plicatus*, an excellent account of which was given by F. Hague in 1856.* Circular pearls are similarly produced round silver wire or other substances, and Dr. Kelaart was of opinion that good pearls might be obtained by similar treatment of the Ceylonese Pearl-Oyster, but such has yet to be proved. The forthcoming Report of Prof. Herdman will probably throw light on this and other interesting points. In the same way an insect in a fresh-water Mussel, a small crab and a fish in the marine Pearl-Oyster, have each been coated with the nacreous secretion.

A recent French author, M. Léon Diguet,† attempts to draw a distinction between what he calls nacreous pearls and fine pearls, which, he affirms, differ from each other in form, aspect, constitution, and physiology. He holds that the nacreous pearl is a concretion of the mantle poured out round a foreign body, as in the case of the Chinese joss, and which under certain circumstances becomes round. It is, he says, a product of the surface of the mantle.

The fine or orient pearl, on the other hand, in contrast with such concretions, is found in the interior of the tissues in a closed chamber, in which it arrives at maturity. During its evolution it passes through a series of transformations, of which he gives three stages, *viz.* (1st) its appearance in a liquid state, as if from irritation caused by a parasite, passing (2nd) in virtue of the elements of saturation to a gelatinous stage like conchyolin; (3rd) by undergoing progressive calcification, constituting a pearl which has a series of concentric layers caused by a special mechanism. In other words, the concentric stratification is affected simultaneously with the penetration of the calcareous solution furnished by the liquids of the organism. The sac or pouch is subsequently ruptured, and the pearl is expelled.

While this ingenious theory does credit to the imagination of the author, it unfortunately is at variance with facts, for, so far as is known, no one ever saw a pearl in the liquid condition here described.

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* 'Journ. Roy. Asiatic Soc. of Great Brit. and Ireland.' Published also by Von Siebold in 'Zeit. f. w. Zool.' Bd. viii. pp. 439–454, Taf. xix. and xx.

† 'Bullet. de la Soc. Centrale d'Agricult. et de Pêche,' July, 1899.

The uncertainty concerning the origin of pearls is probably responsible for some of the statements as to their position in the animal. Thus some record their occurrence in the organ of Bojanus (De Filippi); others, as Bouchon-Brandely (Secretary of the College of France), locate them in the reproductive gland, in the adductor muscle,* in the transverse muscle, as well as in the mantle. Some pearls are found free in the cavity of the shell-fishes, both marine and freshwater—and, indeed, the native divers in Ceylon were sufficiently acquainted with this fact. In this connection it was formerly the custom of residents on the banks of rivers in which *Unios* abounded to drag the bottom for free pearls.†

It can easily be understood also how, when the surface of the pearl projects from its sac, it becomes fixed by the exposed part to the inner surface of the valve. Moreover, it sometimes happens that the pearl becomes embedded in the calcareous mass of the valve during growth, so that all trace of it disappears, only to be again brought into view when the valves are being cut by machinery into discs for buttons. Valuable pearls have thus been procured.

Chemical Composition. — Whilst the nacreous layer of the Common Oyster, according to Schlossberger, contains 94 to 98 per cent. of carbonate of lime, and only 0·8 to 2 per cent. of nitrogenous organic matter, the true Pearl-Oyster has in the same layer only 87 per cent. of carbonate of lime, whilst the organic matter reaches 11 per cent. The hardness of the pearl, which exceeds that of crystals of carbonate of lime, is due to the large proportion of organic matter. This hardness is illustrated, for instance, by the methods of the native dealers in Ceylon, who, by a hammer, fix in wood the small pearls they are about to drill; and Dr. George Harley's experience was similar. Dealers also use their teeth to distinguish between real and fictitious pearls.

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* *Vide*, in this connection, Victor Audouin's 'Observat. pour servir à l'histoire de la Formation des Perles.' Extr. des Mém. du Mus. d'Hist. Nat. Paris, 1828.

† *Vide* "Pearls and Pearl-Fisheries," M. Weber, 'Bullet. U.S. Fish. Com.' vol. vi. p. 321, 1886; C. T. Simpson, "The Pearly Freshwater Mussels of the United States," 'Bullet. U.S. Fish. Com.' vol. xviii. pp. 279–288. Also H. M. Smith, "The Mussel Fishery and Pearl Button Industry of the Mississippi River," *ibid.* pp. 289–314, 1899. See also J. Lawrence-Hamilton, M.R.C.S., 'Pearl and Mother-of-Pearl Industries.' Brighton, 1902.

In the analyses of pearls made in 1888 by Dr. George Harley,* it was found that British, Australian, and Ceylonese pearls all agreed in consisting only of calcium carbonate, organic matter, and water. There was a total absence of magnesia, and of all the other mineral ingredients of sea-water. No phosphates occurred in them (though Rudler says they are present (Encyclop. Brit.)). His (Rudler's) analysis was 91·72 per cent. of carbonate of lime, 5·94 of organic matter, 2·23 of water, and 0·11 loss; and he observes that mother-of-pearl (that is, the nacreous layer of the shell) contained less than half the quantity of organic matter the pearl did.

Age of Pearl-bearing Shells.—Few pearls occur before the third year in the marine Pearl-Oysters; indeed, it is considered that shells which are five years old offer the best field for pearls. From the fifth to the sixth year the Pearl-Oyster becomes more valuable, especially so in the seventh year; the Japanese, indeed, have them up to the ninth year. In the fresh-water forms, such as the Mussel of the Tay, pearls occur in small shells, but it does not follow that the shell is very young. The Americans consider from three to five years as the fruitful period for pearls in their fresh-water Mussels.†

Frequency of Occurrence of Pearls.—The frequency of the occurrence of pearls in the various marine and fresh-water shells is fixed by no law. Hundreds of pearl-shells may be examined without finding a single pearl; but, on the other hand, a single Ceylonese shell will occasionally produce a pearl worth a thousand pounds. An experienced pearl-fisherman of the Tay considered that perhaps one in a hundred contained a pearl. In a group of thirty-one examined by Mr. Alex. J. H. Russell, M.A., fifteen had no pearls, and sixteen had one or more; so that nearly 50 per cent. in this instance had pearls of a kind, for they were of no value. Of these eight contained only one pearl, four had two, two had four of different sizes. The next collection of Mussels, however, and which exceeded the former in number, did not contain a single pearl. The former series came from a curve of the Tay, which has always been rich in pearls, and abounds in Otters. The Otter, like the Racoon, Mink, and Musk-Rat of North America, probably preys on the the Mussels (Jameson), and it may be that the adult stage of the parasite will be found in it. In North America, where fresh-water Mussels abound, hogs are very fond of them, going into the streams when low and rooting them up. Crows likewise carry them up trees, and drop them to break the shells. In the rivers they are eaten by Cat-fishes.

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* 'Proceed. R. S.' vol. xlviii. p. 462.

† Prof. Herdman thinks there is little or no superficial increase of the shells after the fourth year, though they may grow thicker. *Op. cit.*, p. 136.

In order to test the frequency of their occurrence in the Common Mussel of the Eden, Mr. Alex. Russell, M.A., examined 700.* Of this number 620 were large and 80 small—some very small—Mussels. Of the 620 large Mussels, pearls were found in 280—that is to say, 340 had no pearls; and of the 80 small Mussels, 20 had pearls, and 60 were devoid of them. In dealing with the pearl-bearing forms both large and small, and which thus number 300, the following table gives the precise number of pearls in each series, as well as the totals;—

No. of Pearls.	1	2	3	4	5	6	7	8 or more Pearls.	Totals.
Large Mussels	136	67	31	15	7	14	3	7	280
Small ,,	12	—	5	—	1	—	—	2 (12 pearls)	20
Totals.........	148	67	36	15	8	14	3	9	300

The proportion of the 300 pearl-bearing Mussels to the total number (700) is thus 42·8 per cent., but if the large Mussels alone are considered, the proportion is higher, *viz.* 45·1 per cent., which indicates that the Common Mussel more or less follows the same law as the Pearl-Oyster, *viz.* that the older forms produce most pearls. Indeed, the number of pearls in the very small Mussels at St. Andrews is noteworthy, and may be explained by the fact that the very small are not necessarily young Mussels, as a glance at the crowded masses of minute forms on the rocks show. As formerly pointed out by Dr. Wilson and myself, though stunted they are ripe, and it may be the same explanation will suffice for the pearls, which occurred in 25 per cent. of them. It will thus be evident that pearls appear in the Common Mussel as frequently as in the Pearl-Oyster, and more frequently, as a rule, than in the fresh-water Pearl-Mussel, but generally their lack of lustre and beauty makes them of little value.

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* 'Ann. Nat. Hist.' ser. 7, p. 549, June, 1903.

In connection with Dr. Lyster Jameson's views that the Eider-Duck and the Scoter are the final hosts of the parasites which form the nuclei of the pearls in the Common Mussel, it may be stated that both occur in the estuary of the Eden, and feed on the Mussels. It is possible also that other species amongst the many birds frequenting the Mussel-beds, such as the Oystercatcher, may be found to harbour the same parasite.

In relation to the statement of Sir E. Home—that the ova of the Mussel form the nuclei of the pearls in the mantle—is the fact that pearls are found in the males, where no eggs are, as well as in the females.

Mode of Capture.—Marine pearls, whether from the true Pearl-Oyster or the larger bivalve pearl-shells, are procured by diving, since the shell-fishes inhabit water of some depth.* Each boat has relays of men, so that as little time as possible is lost during the season, which is regulated in most places by statute, so as to prevent impoverishment of the beds. In general, a rest of four years is given for each bed in Ceylon. Many descriptions of the fishery in Ceylon have been given, such as those of Albrecht Heerport in 1666, Mr. le Beck in 1797, and Mr. Percival in 1803. The account of Mr. le Beck of the fishery in one of the most productive seasons in the Gulf of Manaar, in Ceylon, is of special interest.† The fishing commences in February, and is carried on for a period of thirty days, according to agreement. His graphic description of the transformation of the barren region of Condatchy—usually so quiet—into a bustling place, where thousands of people of different colours, countries, and occupations congregate, the tents and huts on the seashore with shops or bazaars in front, and the richly laden boats returning in the afternoon, would in many respects suit modern times. Each boat held ten divers, but only five sets of stones of 30 lb. weight (as sinkers), and five nets (as collectors), as only half of the men are at work at a given time. The divers remain below from "two to three minutes," "rarely four to five minutes,"* and bring up about one hundred Pearl-Oysters, which are of small size—from 2½ to 3 in. at most. An Australian pearl-shell diver will bring up 30 lb. weight each time, but each shell-fish is from 6 to 10 in. in diameter, and weighs 2 lb.

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* From Prof. Herdman's observations the usual depths appear to range between four and fourteen fathoms. *Op. cit.*

† 'Asiatic Researches,' or 'Transactions of the Bengal Society,' 1799.

Besides the fishes which eat the pearl-shells, the valves are attacked by a boring sponge, by marine worms, by *Murex*, and "Pholades," and occasionally small hard shells, such as *Cerithium*, get between the edges of the valves and prevent closure, so that Hermit-Crabs get in and devour the soft parts. Starfishes are equally destructive, as in the case of the Common Oyster. Pea-Crabs are also found internally. Externally are various polyps (Zoophytes), Ascidians, and Serpulids.†

Pearl-fishing in fresh waters is carried on chiefly when the rivers are very low in June, July, and August—at a time when such rivers as the Tay can in most places be forded. The bed of the river is covered with rough stones, between which patches of gravel or sandy gravel occur. In these patches the Pearl-Mussels are found—the broader (anterior) end of the shell, with the mouth and foot, sunk deeply, whilst the posterior end, with the dark brown fringe of the mantle, projects above the surface. Respiration is thus readily carried on, and the currents likewise convey food. In rivers such as the Tay the ripples on the surface render it difficult to see objects on the bottom. Accordingly the pearl-fishers carry a rude kind of water-telescope, which enables them to take in a considerable range of the bottom, and readily observe each shell, which is removed by a forked stick, or an iron instrument of similar shape. In many places the stones in the bed of the river are covered by a bright green coating of the fresh-water Sponge (*Spongilla lacustris*, not *fluviatilis*, as might be supposed), and insect larvæ and their tubes abound in the gravel. Eels are the only fishes observed. A great and unnecessary waste of shell-fish life takes place from the primitive methods still used to obtain the pearls, both in this species and in the marine forms. Instead of slitting the two adductor muscles, or the single one in the Pearl-Oyster, a screw-lever can be used for opening the valves sufficiently for inspection. The molluscs can thus be returned to the water, and may develop another pearl.

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* Prof. Herdman states, from personal observation, that none reached two minutes, and few over a minute and a half. *Op. cit.* p. 64.

† Prof. Herdman mentions, amongst other natural enemies, *Modiola barbata*, which, when in quantity, smothers the young Oysters. *Op. cit.* p. 121.

Artificial Pearls.—Jaquin made artificial pearls for Catherine de Medicis of glass, and with the silvery scales of *Cyprinus alburnus*. Similar artificial pearls were in the London Exhibition of 1851. At the present time their manufacture by a different process is carried out extensively in Paris.

Pearls as Medicine.—Besides ornamental purposes, in olden time (a century ago) pearl-powder was used as a medicine for many diseases, just as powdered ivory and musk lingered till our own day. Some pearls, again, were reduced to powder or chunam, to be used with betel-leaf and areca-nut as a masticatory.

Reproduction.—Considerable obscurity still remains in regard to the spawning of the Pearl-Oysters. Léon Diguet thinks this occurs in autumn. The Japanese Pearl-Oyster, again, spawns from June to August.*

Mother-of-Pearl Industry.—A few words may now be said about the mother-of-pearl industry. The valves of the various Pearl-Oysters are extensively used in papier-mâché work, in inlaid work, and in the decoration of ecclesiastical vestments in Russia. The Chinese, Siamese, Japanese, and Turks are great in inlaid work, and they also employ powder made from *Trochus* and *Haliotis*. In our own country a large trade is carried on in button-making, in the manufacture of breast-pins, earrings, cane- and umbrella-handles, card-cases, boxes, studs, napkin-rings (*Trochus*), artificial catseyes, and beads. Cameos are also carved on mother-of-pearl shells (such as the dark varieties, *e. g.*

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* Prof. Herdman's observations (*op. cit.* pp. 125, 126) would seem to point to May as the central spawning month, though many may spawn earlier and later, as with the Common Mussel.

Tahitian pearl-shells). The remarkable Fiji Island dresses of shells made of sections of a large Pearl-Oyster are still in some museums.

The iridescent colours of fossilized shells are retained in the ammonites from the Jurassic and cretaceous limestone (Lumachelle marble), which resemble in their lustre the fire-opal from Mexico.

From the fresh-water *Unios* little portmanteaus, satchels, &c., are formed, and they are very beautiful when both the exterior and interior are perlaceous.

We have thus taken a rapid glance at a comprehensive subject—a glance sufficient, however, to show the vast resources of nature for scientific investigation and scientific culture. The great variety and beauty of pearl-shells and their pearls have for ages proved sources of the deepest interest to man, both savage and civilized, and the recent discoveries in regard to the formation of pearls indicate that that interest is by no means diminished as time advances. Here in St. Andrew's we are in the midst of a fine field for experimental work in connection with pearl-formation, both in the fresh-water Mussels of the Tay and the marine forms in the estuary of the Eden. The task would involve labour and care, but it would not be more complex than those recently carried out in connection with the mosquitoes and malaria, or than some of the more intricate bacteriological investigations of the day; whilst a successful result might lead to other advantages which do not usually fall to the lot of scientific workers.

Note.—Since the foregoing was written, Prof. Herdman's first volume of important observations on the Ceylonese Pearl-Oyster has been published,* and in this he shows that the most important cause of pearl-formation is a larval cestode of the *Tetrarhynchus* form, the free embryos of which become encapsuled in the Pearl-Oyster, the late larval stages being in File-fishes which eat the Pearl-Oysters, and, lastly, the adult in a large Elasmobranch (*Trygon*).† Prof. Giard‡ has also pointed out that M. G. Seurat has just found a cestode parasite as the cause of pearl-formation in the region of the Gambia. An older stage, moreover, occurred in *Balistes*.

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* "Ceylon Pearl Fisheries," &c. Roy. Soc. 1903, pp. 11–13.

† 'Nature,' Dec. 10th, 1903.

‡ 'Comp. rend. Soc. Biol.' Oct. 31st, 1903, tome lv. p. 1222, with figs.

It is interesting also to observe that the behaviour of the Pearl-Oyster spat* is in most respects the same as that of young Mussels, even to the coating of seaweeds and zoophytes, and their habit of detaching themselves at will.

For the photographs of sections of pearls, I have to thank my colleague, Prof. Musgrove, who kindly undertook the work. Figs. 2, 3, 4, and 5 were printed by Mr. A. W. Brown, of the Gatty Marine Laboratory.

Plate I.

Fig. 1.—Section of a Tay pearl in its natural condition. The radiating and concentric lines are boldly indicated. This specimen was presented by B. C. Cox, Esq., of St. Andrews. Magnified.

Fig. 2.—Section of a Tay pearl after decalcification. The whole field is minutely reticulated, and traces of two nuclei are indicated. Magnified.

Fig. 3.—Section of a decalcified pearl from the Pearl-Mussel of the Tay, made like the former by Mr. A. J. H. Russell, M.A. The radiating lines of conchyolin are very prominent, whereas the concentric lines are less so. Magnified.

Fig. 4.—Section of a decalcified pearl in its capsule from the mantle of the Common Mussel. In this the conchyolin forms fine concentric striæ around the nucleus. No radiating lines are visible. The ova of the Mussel (a female) fill up the mantle beyond the capsule of the pearl. Magnified.

Fig. 5.—Section of a decalcified pearl (small) in the mantle of a Pearl-Mussel from the Tay.† It is surrounded by a well-formed cellular capsule. Minute reticulations and concentric lines of growth are visible, as well as several nuclei. Magnified.

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* 'Nature,' Dec. 10th, 1903, p. 69.

† I have to thank Mr. Lumsden, the Superintendent of the Tay Salmon Fisheries, for his courtesy in forwarding living examples of the Pearl-Mussels.

NOTES ON THE SEAL AND WHALE FISHERY FOR 1903.

By Thomas Southwell, F.Z.S.

The prospects for the Newfoundland sealing in the season of 1903 were good from the first, and it was brought to a successful conclusion without any untoward circumstances, or a repetition of the unpleasant features which marked the preparations for the previous voyage. The fleet, by the addition of the 'Grand Lake' and the 'Windward,' was increased to twenty-two vessels, six of which left St. John's on the 10th of March with the good wishes of all concerned.

The eastern Seals were found about forty miles N.E. of the Funks, and, as they covered a comparatively small area, and lay very thick, notwithstanding the ice being heavy the work proceeded rapidly; the Hooded Seals, however, were very scarce.

The first to return was the 'Virginia Lake,' on the 28th of March, with 22,677 Seals, to be followed on the 29th and 30th by the 'Aurora' and 'Greenland,' both well-fished; others arrived in quick succession. The 'Virginia Lake' found the breeding patch on the 17th, and in the two following days had the bulk of her young Seals on board, which consisted of 21,582 young, 257 Bedlamer, and 205 old Harps; also 483 young and 150 old Hoods.

The weather throughout the spring was terribly cold, and high winds prevailed; the ice was heavy, and the frozen slob thickly covered with White-coats, the patch being described as the largest seen for many years; the work for the men was therefore very heavy, and they laboured at killing and panning until overcome by sheer fatigue. As most of the vessels were well into the patch, it was speedily cut up, and after the first scramble little else was done. After getting the pelts on board they headed E.N.E. in search of Hoods. This fairly epitomises the proceedings of all the vessels of the eastern fleet.

Owing to favourable weather at this stage of the voyage, which, however, did not last long, the losses from the objectionable practice of "panning" do not seem to have been so heavy as usual; it often happens that through eagerness to secure as many Seals as possible in the short time available, many more are killed and the pelts panned than can afterwards, owing to bad weather, the breaking up of the ice, or other causes, be recovered, thus involving much useless sacrifice of life and property.

Of all the northern fleet, the 'Windward' was the most unfortunate. Although she arrived early at the breeding patch, she was unable to force a passage into the ice, and, other troubles following, she had to return with only 1185 Seals. The young Seals were in excellent condition, the average weight of the fat being 40 to 46 lb.

Of the Gulf sealers the report is not so good, the four vessels only securing about 34,000 Seals between them. The captain of the 'Newfoundland' reports that he first struck the Seals on the 12th March, eight miles south of the Bird Rocks, but was unable to get near them. All through the spring the vessel was jammed more or less, and it was not till the 23rd or 24th of March that any number of Seals were taken; these were quite in the centre of the Gulf. "The ice," says Capt. Farquhar, "was in enormous sheets three to ten miles wide, and the weather so bad that men could not work. Had the weather been fine a big catch would have been assured, but the distance travelled by the men was too great." His final result was 10,530, almost all young Harps. The 'Harlaw,' with the 'Algerine' and 'Nimrod,' found the Seals off Cape Anguille, but they all became jammed, and, although there were Seals all around, the ice was so heavy that they could not be got at. The 'Algerine' was the most fortunate of the Gulf sealers; she had about 8000 young Harps, and 2000 young and 2200 old Hoods, some of the latter being very heavy. Her catch altogether numbered 12,820, and but for the heavy nature of the ice might have been larger still. As it was, her nett weight was 331 tons, a trifle more than the 'Iceland's' 16,337 young Harps, although they also were very fine.

The average take of the twenty-two vessels was 14,444 Seals, twelve of them being above that number, and ten below. Twelve vessels had more than 15,000, three between that number and 10,000, and seven less than 10,000. The 'Aurora' headed the list with 26,069 (1652 of which were old and young Hoods), and the 'Windward,' for the reasons already explained, brought home only 1185. The total catch of the steamers was 317,760 Seals, valued at £89,958, against 274,539, estimated at £80,525 in the season of 1902. To these must be added those taken in the northern shore fishery, and by the schooners on the west coast.

Commercially, the past season must have been a very remunerative one; the trade has drifted virtually into the hands of three firms, and fresh markets are opening for the products, both oil and skins. The editor of the St. John's 'Evening Herald,' commenting upon the season's fishing, remarks:—"The American demand for skins is now so great, consequent upon the discovery of a new and improved process of tanning them, that an advance of twenty to forty cents. in the price of them, according to size, is confidently expected in the near future." Instead of depending upon the English market alone for the disposal of the oil and skins, the American demand is said to be for more than the entire catch, and the probability is that the fleet will be further augmented. "Years ago Seal-oil fetched only £18 per tun in London, whereas it now fetches £28, and skins then were worth only 2s. 6d. each, whereas they now realize 3s. 6d. each. . . . In the face of these figures it is clear that the sealing industry will take on a new lease of life, so to speak"; but the look-out for the Seals themselves, owing to this increased impetus in their pursuit, is a black one. That the supply has not shown signs of exhaustion hitherto is difficult to understand, and seems to point to a reserve of breeding Seals, the whelping haunts of which have not hitherto been discovered.

Happily no accidents or untoward incidents have this season to be reported, in addition to the hardships incidental to this arduous and perilous enterprise.

The 'Terra Nova' has been purchased by the Government to join the 'Morning' as a sister relief ship to the 'Discovery,' now engaged in Antarctic research. She sailed for the south on 26th August, 1903, and the 'Windward' goes to replace the 'Vega,' whose loss I shall have to record below.

The whaling fleet again consisted of five vessels, the 'Vega' taking the place of the lost 'Nova Zembla'; to these must be added the ketch 'Alert' of ninety-seven tons, now wintering in Pond's Bay, and the 'Greda,' a chartered Norwegian schooner, which brought some produce from Cumberland Gulf station. All these, with the exception named below, hail from Davis Strait. The Greenland Seas were again unvisited by the British whalers.

Once more the pitiless ice of the Polar Seas has claimed its victim; in the season of 1902 it was the 'Nova Zembla,' which went to pieces in Dexterity Fjord. In the past season the 'Vega,' on her first whaling voyage from Dundee, was crushed in the dreaded floe of Melville Bay, and went down so quickly that her crew had barely time to take to their boats and escape.

The first vessel to arrive home was the 'Active,' which reached Dundee on the 20th of October from the scene of her operations in Hudson Strait and the neighbourhood of Southampton Island, where her owners have a winter station. After visiting the mines and taking on board the talc there awaiting her, she proceeded to the station on Southampton Island, which was reached on the 17th of July, and thence to 'Kikerton' (the native name for any group of islands), where all her five Whales were taken. The bone of two, but not the blubber, was obtained by barter from the natives, two were killed by the ketch 'Ernest William,' and one was captured at the beginning of September by the crew of the 'Active.' One of the Whales was small, with only five feet of bone, another of six feet, and the remaining three yielded bone of over nine feet, one being a fine fish of 10 ft. 3 in. bone, a large size for this locality. The capture of this last Whale was rather an exciting event. When harpooned it made direct for the loose ice, and soon ran out all the lines; the crew, however, cast off and buoyed the line, and, rowing round to the other side of the floe, again picked it up. Finally, after eight hours' exertion, they succeeded in securing their valuable prey. The 'Active's' voyage was a very successful one; she brought home the produce of 5 Black and 34 White Whales, 78 Walruses, 125 Seals, and 46 Bears, yielding 26 tuns of oil and 41 cwt. of bone; also the skins of 10 Musk-Oxen and 127 Foxes, which were obtained from the natives.

The Liverpool steamer 'Eldorado,' engaged in the fur trade, struck a sunken rock off the George River, in Ungava Bay, at the entrance of Hudson's Bay, and foundered at once, her crew of forty-seven men barely escaping with their lives. After great hardship from exposure to cold and hunger, and a 600-mile tramp, they reached the Temiscapping Railway, and finally arrived safely at Montreal. Such are the dangers of this ill-charted sea.

The east side fishing-grounds were visited, but not a single Whale seen. The four vessels therefore proceeded north to Melville Bay, where they were all beset. The 'Vega,' a fine vessel of 357 tons gross, built at Bremerhaven in 1872, and notable as the vessel in which Baron Nordenskjold made his wonderful north-east passage from the North Cape to Berings Strait in the years 1878–9, was on her first voyage from Dundee, which port she left on the 11th April, reaching Melville Bay towards the end of May; here she was beset, and after battling with the floe unsuccessfully for seven days, on the night of the 31st of May the ice penetrated her side, and she went down so suddenly that those of her crew who were in their bunks had barely time to escape, scantily clothed and without boots and stockings. Fortunately her seven boats had been got out, although there did not then seem to be immediate cause for alarm, and the crew of forty-five, half-clothed and badly provided with provisions, took to the boats off Wilcox Point, where the wreck occurred, and, after 6½ days' exposure in open boats to cold, dangerous navigation, and terrible weather, they reached the settlement of Upernivick. After staying here seven days, part of the crew started in two boats to intercept the steamer 'Nov,' which leaves Copenhagen twice a year for the east side Davis Strait settlements, and, after having travelled 300 miles in open boats, they fortunately found her at Egedesminde, and were landed at Aberdeen; others reached Godhaven, and were conveyed to Copenhagen by the Danish mail-packet, and arrived at Dundee by the 'Rona' on 10th September.

The remaining three ships were also fast in the ice. The 'Eclipse,' which was slightly in advance, was the first to escape after very rough handling, but sustaining no material damage. The 'Diana' was not so fortunate; on the 6th June she was badly nipped, and her rudder smashed. Three days later her spare rudder was also rendered useless, and she had to avail herself of the assistance of the crews of the other vessels to make good as far as possible the damages sustained. After much blasting and cutting the two ships got free, and pursued their voyage northward, having been fast for seventeen days.

Not so, however, the 'Balæna,' between whom and the open water there intervened a solid barrier of ice a mile in extent, defying all their efforts to force a passage through; no sooner was a space cut than the floe closed in, rendering fruitless all their efforts, and her rudder was carried away by the pressure. It was not till the 15th August that she got clear of the ice, having been imprisoned for seventy days. This misfortune came after having her foretop-gallant mast and mizzen-topmast carried away on the 26th April in a gale off Cape Farewell. But the gallant crew, notwithstanding the severe ice work during their long detention, were not neglectful of the main object of their voyage. On the 28th July a Whale was seen, and, dragging the boats a mile over the ice, they gave chase, but returned empty-handed. A second attempt on the same day was equally fruitless. On the 30th several Whales were seen, with a like disappointing result, and the next day they actually got fast to one, but the harpoon drew. On 1st August yet another fish was lost. Could anything be more disappointing to the imprisoned crew? It was not till off Cape York that the 'Balæna' killed her first and only Whale, a fine fish of 10 ft. 8 in. bone, and she bore up for home on the 31st October, after having visited the west side fishing-grounds, where plenty of Whales were seen, but the sea was too heavy to permit of the boats putting off.

The 'Balæna's' catch consisted of 1 Whale, 4 White Whales, 2 Walrus, 6 Seals, and 35 Bears, yielding 14 tuns of oil and 18 cwt. of bone.

We left the 'Eclipse' just escaping from the ice in Melville Bay. Thence she made good progress to Cape York, where she had another slight nip, but reached the station in Pond's Bay on 3rd July. In the middle fishing-grounds a small Whale of 5-ft. bone had been captured, and on Sept. 20th a large Whale near Coutts Inlet, 11 ft. 3 in. bone; but it was on the 22nd October, at Katerhead, that she met with the crowning stroke of good fortune, killing two other Whales of 12 ft. 3 in. and 11 ft. 3 in. respectively, thus making a brilliant finish. A week later she bore up for home, and arrived on the 15th November, having the produce of 4 Black and 33 White Whales, 1 Walrus, 36 Seals, and 38 Bears, yielding 49 tuns of oil and 68 cwt. of bone.

The 'Diana,' after her exciting passage through Melville Bay, reached the north water on 26th June. Her first Whale was seen and lost on 6th July, but the next day they were fortunate enough to secure a large fish, yielding 12 ft. 6 in. bone, and a second very small Whale of 4 ft. bone on the 20th July in Pond's Bay. She reached Dundee on the 15th November, having on board 2 Black and 4 White Whales, 3 Walrus, 18 Seals, and 16 Bears, representing 23 tuns of oil and 26 cwt. of bone.

The features of the voyage have been the bad weather experienced, and the heavy character of the ice. Many Whales were seen, and doubtless more would have been captured had it been possible to go in pursuit of them. With three exceptions they were all very fine fish.

The total produce, including 2 Black and 4 White Whales, 12 Walruses, 3044 Seals, 4 Bears, 33 tuns of oil, and 22 cwt. of bone, brought home from Cumberland Gulf station by the 'Greda,' was as follows:—14 Black Whales, 79 White Whales, 107 Walruses, 3229 Seals, and 157 Bears, yielding 145 tuns of oil and 175 cwt. of bone, of the approximate value of £28,350, against a like valuation of £32,420 in the previous season. Bone is now selling at the enormous price of £2700 per ton, irrespective of size, which offers a strong inducement to risk the expensive outfit, and to endure the perils and hardships of the voyage. No efficient substitute for whalebone has yet been discovered for stiffening ladies' dresses and whip-handles, its chief uses, and the price seems likely to go even higher still.

I have no precise information as to the number of Bottle-nosed Whales killed by the Norwegians, but, judging from the quantity of this season's oil on the market (about 1600 tuns), it could not be far short of 2000.

The Newfoundland Finwhale fishery continues to be profitable. The spring fishery, commencing in the month of March, is now pursued in Hermitage Bay, where up to July the "Sulphur-bottom" Whales (doubtless *B. sibbaldii*) are killed. After the middle of the latter month Notre Dame or Green Bay is resorted to in search of "Humpbacked" (*Megaptera longimana?*) and "Finwhales" (*Balænoptera musculus?*). About the month of October these Whales become scarce, and finally leave the coast. The following figures, taken from the Report of the Newfoundland Financial Minister's Budget speech of 1903, show the value of the oil and bone produced in each season:—

Years.	Tuns of Oil.	Value of Oil.	Value of Bone.
1897–8	27	1,340 dols.	241 dols.
1898–9	211	14,439 "	1,089 "
1899–0	430	34,604 "	1,814 "
1900–1	635	54,221 "	13,550 "
1901–2	1,275	112,859 "	12,285 "

Of course the bone is short and of very inferior quality.

The value of the Finwhale fishery from the Norwegian ports has fallen off from 1,320,600 kroner in 1897 to 498,000 kroner in 1900, and great complaints have arisen from the fishermen as to the disturbance produced in their fisheries by the operations of the whalers. The Parliament therefore, after due inquiries, has forbidden whaling along the Norwegian arctic coast within seven kilometres from the land for ten years from February next. Probably owing to scarcity of the Whales, and certain restrictions already in force, establishments were extended first to Iceland, then to the Faroes, and lastly to Shetland, where two stations have been established by Norwegian companies at the head of Ronas Voe, and a new station is to be opened in the coming season at Collafirth. Last year the two Ronas Voe companies killed 126 Whales in all. A writer in the 'Shetland News' states that in 1902 the united Norwegian fleets of about fifty-seven vessels accounted for nearly 2500 of these Whales. It does not seem probable that the supply of these animals will long sustain such a strain; they will surely soon be killed out, or desert the seas where they meet with such persecution, and this, in addition to the complaints raised by the fishermen, must render any extension of the industry very precarious.

A feature in the year's record of things cetacean has been the appearance of a considerable "school" of Sperm-Whales in the North Atlantic. In August, 1901, a male 61 ft. long was found dead, and towed into Ronas Voe; but on the 26th June last the

Finwhale fishers from that port actually met with a "school" of five, one of which, a male 68 ft. long, they captured, the remaining four making their escape.

Mr. Percy Bicknall has been good enough to allow me to avail myself of the inquiries he has made as to the captures of Sperm Whales by the Iceland and Norwegian whalers, which give the following results. No dates are given as to when they were seen, nor the precise number of which the "school" consisted, but one letter sets it at thirty. Mr. Bicknall believes that at least six were killed, and one found dead, and that the following dates are approximately correct:—

June 20th.—Two out of a numerous herd, in lat. 63° N. One, 54 ft. long, taken eighty-four (or twelve Norwegian) miles S.S.E. of Reidarsfjord. "No others seen at the same time."

June 27th.—One taken (two or three others seen), lat. 61° N. This is probably the Ronas Voe individual.

July 14th.—One taken (two others seen) in lat. 63° N.

August 14th.—One taken (alone), same locality as the single one, on June 20th; length, 60 ft.

All six are described as bulls, mostly adults. They seem to have dispersed in the deep water between Iceland and Norway, in about the latitude of Trondhjem. From one of the two killed on 20th June a lump of ambergris weighing about 4½ lb. was taken. Mr. Bicknall tells me that in 1898 a Mincing Lane merchant had a piece of ambergris weighing 270 lb., which was sold in Paris for something like 85s. per oz., or £18,360. The price of ambergris varies considerably, but that of good quality averages about 60s. to 80s. per oz.

My best thanks, as usual, are due to my obliging correspondents, Mr. Robert Kinnes, of Dundee, and Sir Richard Thorburn, of St. John's, Newfoundland; also to the editor of the St. John's 'Evening Herald,' for their kind assistance.

ORNITHOLOGICAL NOTES FROM MID-WALES.

By Professor J. H. Salter, University College, Aberystwith.

The following notes form a continuation of a series, referring chiefly to the neighbourhood of Aberystwith, which has appeared in 'The Zoologist' at intervals during the past ten years.

1902.

January 7th.—An unusually large flock of from two to three hundred Redwings. Owing to absence of snow, scarcely any Fieldfares seen this winter.

28*th.*—Mr. C. E. M. Edwards, of Dolgelley, informs me that Black Game are upon the increase in that neighbourhood. A Grey Hen reared a brood upon Cader Idris in the summer of 1901.

February 9th.—Two Tree-Sparrows again at the stackyard where I first met with this species, which had not previously been recorded for Cardiganshire (Zool. 1902, p. 25). With reference to the distribution of this bird in North Wales, Mr. H. E. Forrest writes:—"Last May I identified the Tree-Sparrow—quite a little colony of them—at Llanrwst. It also occurs at Conway, Colwyn Bay, St. Asaph, and in Anglesea, along the Shropshire border of Montgomeryshire, as also in parts of Denbighshire." As regards the Lesser Whitethroat, Mr. Forrest states that "this bird is more plentiful in Montgomeryshire than elsewhere in North Wales, particularly along the Severn Valley as far west as Newtown. It also occurs in several parts of Flint and Denbigh, though local and nowhere numerous. Capt. Swainson heard it in July, 1895, at Llanidloes. Its numbers vary immensely in different years; it was specially numerous in 1895 and in 1901." Mr. H. S. Davenport tells me that he found this species quite abundant last May at Llanuwchllyn, in the vicinity of Bala Lake. Six pairs were nesting close to the village.

10*th.*—Mr. Feilden writes of having seen a flock of about thirty Curlew-Sandpipers on the golf-links at Borth.

March 10*th*.—Curlews, Oystercatchers, and Redshanks very noisy after dark.

26*th*.—The Ravens' nest at Yr Garreg contained two newly-hatched young and an addled egg.

28*th*.—The heronry at Llidiardau, Llanilar, now numbers only five or six pairs.

April 23*rd*.—Two Swifts hawking over Borth beach—an early date for this migrant, which in general arrives with the utmost regularity on or about May 3rd.

30*th*.—A brood of young Grey Wagtails left the nest to-day. In this case the first eggs must have been laid during the last few days of March.

May 3*rd*.—Cirl-Buntings' nest with three eggs in furze.

8*th*.—In the hill-district noted large parties of migrating Meadow-Pipits not yet dispersed, though others were breeding.

14*th*.—Turnstone at the mouth of the Dovey.

17*th*.—A pair of Peregrines breeding in a cliff which overlooks one of the small mountain lakes. From a nest in the same rock, Ravens had brought off young earlier in the season.

19*th*.—While snow-showers whitened Snowdonia, made a careful search for the Twite upon the picturesque mountains of the Rhinog range, in the neighbourhood of Cwm Bychan and the Roman Steps. My quest was unsuccessful, though parts of these hills are covered with tall heather, and the locality appears in every way most suitable. Mr. D. B. Grubb, who was here at Easter, writes:—"I was interested to find Linnets, which I imagined to be Twites, amongst the heather on Rhinog Fawr." Yet no one, so far as I am aware, has yet found this species breeding in Wales.

24*th*.—Mr. Grubb observed Dunlin, evidently breeding, upon one of the mountain-bogs between the Yrfon and Towy (Breconshire).

25*th*.—Heard Turtle-Dove. This bird has become decidedly more numerous, or rather less scarce, here within the past ten years.

28*th*.—A pair of Wood-Wrens nesting for the third year in succession at precisely the same spot.

31*st*.—Found the Lesser Redpoll, which I have hitherto regarded as a winter visitor to this district, remaining to breed in some numbers in the vicinity of the town (Zool. 1903, p. 106).

June 5th.—Amongst the Lesser Black-backed Gulls, at their colony upon the Teifi Bog, observed an adult Herring-Gull. This confirms the truth of a statement made to me some years ago to the effect that one or two pairs of *L. argentatus* nest here with the more numerous *L. fuscus*.

23*rd.*—Noted that young Garden-Warblers, when alarmed, drop out of the nest and hide in the undergrowth long before they are able to fly.

July 2*nd.*—Mistle-Thrushes already flocking.

5*th.*—A pair of Choughs near the Monk's Cave.

9*th.*—Numerous well-fledged young Herring-Gulls upon the nesting-ledges. About fifty Guillemots and a pair of Great Black-backs breeding at New Quay Head. Visited a breeding station of the Cormorant. The nests and vicinity were populous with young birds, fully fledged, and just ready to leave the ledges. Some of them, becoming nervous, took flight, but first lightened ship, throwing up their last meal of partly-digested fish, in pieces about the size of Sprats. An old Cormorant came in to feed its brood. With head down, wide-open beak, and quivering wings, it was surrounded by its scuffling, fluttering young, which put their heads one by one into its mouth and seized the savoury morsels from its pouch.

22*nd.*—Starlings now distributed in flocks over the mountains, accompanied by flanking parties of Mistle-Thrushes.

September 24*th.*—Chiffchaff sang.

26*th* —Stonechat singing and "chacking," as in spring.

November 2*nd.*—Cirl-Bunting singing.

14*th.*—House-Sparrows hawking gnats.

December 12*th.*—A Black Redstart by the College.

1903.

January 15*th.*—At the taxidermist's, saw the Norfolk Plover which was obtained near Towyn on the 6th inst. (see note by Mr. H. E. Forrest (Zool. 1903, p. 154)). Only one Bittern received this winter so far.

February 11*th.*—Saw a Dotterel, apparently a bird of the year, said to have been shot on the hills on Sir Pryse Pryse's property last August or September.

March 10*th*.—Three Golden Plover near Plynlimmon, as yet showing no sign of summer dress.

13*th*.—Owing to the wet and rough weather, Ravens only began to lay about this date.

28*th*.—I hear of Black Game reappearing in more than one Cardiganshire locality. They are probably wanderers from the adjacent parts of the counties of Radnor, Brecon, and Carmarthen, where this species has always maintained itself, though latterly in small numbers.

April 2*nd*.—Was introduced to a Welsh haunt of the Wood-Lark. A warm southern hillside, diversified by outcrops of grey rock amongst the withered bracken, sloped to the Wye. Quite half a dozen pairs were breeding here. One could not walk far in any direction without hearing the soft flute-like note of the male bird as he sang, sometimes hovering in the air, but quite as frequently from the ground. Other pairs were chasing and coquetting. Though the birds seemed tame, and it was easy approximately to locate each nest, they were in reality very shy of giving any indication of its exact whereabouts. The site usually selected is under shelter of the dry beaten-down fern. So early a breeder is the Wood-Lark that, in spite of the wet and cheerless weather of the present spring, a nest contained much incubated eggs on March 28th; another bird was beginning to sit on April 1st.

5*th*.—A pair of Goldcrests have a nest ready for lining.

6*th*.—Swallows already crossing the bleak and dreary hill-range of the Eppynt. Mr. Forrest saw Ray's Wagtail at Rhayader. A number of dates with which I have been furnished tend to show the very early arrival of the migrants in the Wye Valley, accounted for by the fact of its being a main artery of distribution. This was exemplified in 1893, when I saw the Common Redstart some distance above Rhayader on March 29th.

11*th*.—A Ravens' nest near Devil's Bridge contained five young birds, which were almost fledged, a little greyish down still showing amongst the feathers. Another nest, which I heard of as long ago as 1895, contained much smaller young.

May 2*nd.*—A Hoopoe at the taxidermist's, said to have been obtained at Talybont.

9*th.*—Met with the Lesser Whitethroat in Cardiganshire, for the first time during twelve years' residence (Zool. 1903, p. 226).

11*th.*—A pair of Ravens skirmishing with Rooks over the Penglais Woods.

23*rd.*—A Cuckoo passed over calling on the wing (see discussion in Zool. 1894).

June 5*th.*—The Lesser Black-backed Gulls being considered destructive to game upon the Teifi Bog, it has been resolved to expel them. The keeper informed me that about 130 eggs had been gathered, and a number more destroyed. It is doubtful whether half a dozen young were brought off. Colonel Fryer, the lessee of the shooting, tells me that the only point in their favour is that they destroy Adders. It would be interesting to have this confirmed. Cuckoo's egg in a Tree-Pipit's nest.

10*th.*—About a dozen pairs of Lesser Terns breeding at Ynyslas. This is the only nesting site of this species on the Cardiganshire coast.

August.—Goldfinches have greatly increased in numbers in this neighbourhood, owing to a succession of mild winters, and to their being now protected throughout the year.

29*th.*—Swift last seen.

31*st.*—Chaffinch's imperfect summer song; again on September 25th.

September 13*th.*—Had the pleasure of meeting Mr. E. Cambridge Phillips, the veteran Breconshire ornithologist. Heard details of a recent occurrence of the White-tailed Eagle at Cantref, near Brecon, and of that of a Little Bittern at Llangorse Lake. Mr. Phillips showed me local specimens of the Hobby, Great Snipe, and Crossbill, Spotted Crakes from Onllwyn Bog, and (of still greater interest) the pair of Firecrests referred to in 'The Birds of Breconshire.'

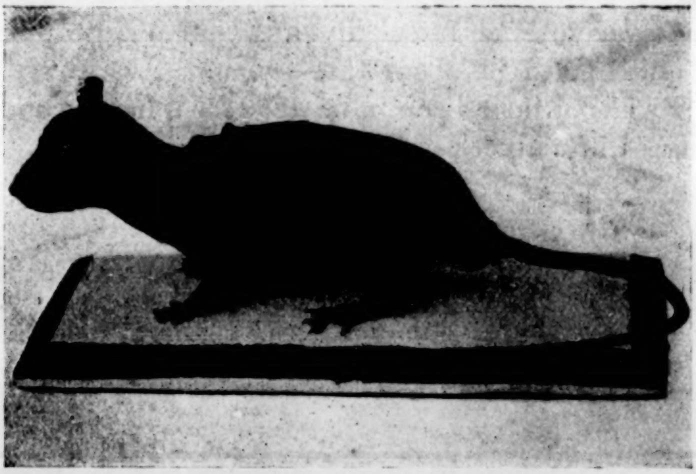
16*th.*—Ring-Ouzels at the rowan-berries. Saw a fine Falcon (tiercel) on the wing in a remote part of the county, close to the Breconshire border.

November 10*th.*—Mr. F. T. Feilden, of Borth, who has most obligingly furnished me with notes for a number of years, reports having met with a small party of Black Terns at the mouth of the Leri. He writes:—"On February 27th I killed the finest old Heron I ever saw, and as the colour of the legs and bill was very remarkable, I made notes of them before the bird was dead. Bill from base crimson, blending into orange-vermilion, Indian yellow, and aureolin at tip. Eye, scarlet outer circle (iris), straw inside. Legs, upper part vermilion, lower yellow spotted with vermilion. Longest crest-feather, 7¼ in.; tip to tip of wing, 5 ft. 1 in.; full length, 39 in. I got a Tufted Duck on September 24th; also a fine drake Merganser, changing from the female plumage. The breast was almost orange in colour, and I took it for a Goosander at first. This colour quite faded in about three days. I narrowly escaped shooting a Peregrine Falcon in mistake for a hen Sparrow-Hawk as it dashed into a flock of Starlings."

NOTES AND QUERIES.

MAMMALIA.

Hairless Rat.—I have recently had in my possession a stuffed specimen of a hairless Rat (*Mus rattus*, male). It was kindly lent to me for inspection by Mr. Ernest Lowe, the Curator of the Plymouth Museum and Art Gallery.*



The Rat was caught alive in October, 1898, in the victualling yard of the Ordnance Store Department at Stonehouse, Devenport. At the time of its capture it was in possession of a few long woolly hairs, besides the whiskers. When the animal was at rest the skin appeared all creased and wrinkled, but in active movements the folds disappeared. The Rat measured 7 in. from the muzzle to the root of the tail, taken along the contour. The tail, which was not perfect, measured 6⅝ in. in length. The ambit, behind the scapulars, 5⅜ in. Skin granulated, dirty brown. Hind feet webbed to half length of first phalanx. Tail hairless; scutellæ cycloid, encircling, but somewhat widely separated, and attached all round. Ears also quite nude. The loss of hair is attributable to disease.—T. Edward Belcher (24, Clapham Road).

[For another record of a hairless Rat (*M. decumanus*), *cf.* 'Zoologist' (1903), p. 454.—Ed.]

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* Mr. Lowe tells me that the transverse folds of skin across the shoulders are the work of the taxidermist; there were folds, but they were further back, and not transverse.

AVES.

Late Breeding of the Martin (Chelidon urbica).—Does not this species regularly continue nesting later than any other British breeding bird? This is my experience, and I see that more than one correspondent (Zool. 1903, p. 455, and *ante*, p. 32) calls attention to its late nests. From my own note-book of personal observations I take the following: "Martins feeding young in nest at Wellington, Somerset, Oct. 11th, 1888." The following personal records all refer to Scarborough: "A pair breeding young in nest, Oct. 1st, 1898." "Young in nest, Sept. 18th, 1899." "Feeding young at two nests, Sept. 29th, and at one nest, Sept. 30th, 1900." Of late occurrences of the bird here I have the following notes: "Saw one on Nov. 22nd, 1904, and heard of its being about the same place in December of that year." "Saw one on the South Cliff, Dec. 16th, 1900. One was shot on the North Cliffs, Dec. 23rd, 1900."—W. Gyngell (Scarborough).

Autumn Song of the Cirl-Bunting and Dipper.—Several articles, including one from Mr. Aplin in 1894, have appeared in 'The Zoologist' on the autumn song of birds, but I have been unable to find the two above-mentioned birds in any of the lists. In this district the Cirl-Bunting (*Emberiza cirlus*) is undoubtedly an autumn songster, and may occasionally be heard singing every year in that season. This Bunting is one of our most persistent singers; the regular song commences about the end of March, and continues to mid-August. I also hear it occasionally every year in September and October. On Oct. 5th and 6th, 1892, I happened to be Salmon-fishing on the Usk, at Glan Usk pool, near one of the haunts of the Cirl-Bunting, and heard the song of this bird at intervals during several hours on each day. On referring to my notes I find I have, in the last fourteen years, heard the song in every month except December, the earliest date being Jan. 25th, 1892, and the latest on Nov. 2nd, 1900—a fine warm day with a shade temperature of sixty-one degrees. Strange to say, I have very rarely heard its much commoner congener, the Yellow Bunting, between the beginning of August and the end of February. The Dipper, which is perhaps as common here as in any part of the kingdom, sings, as is well known, nearly all the year round. I think its song is to be heard on more days in the year than any other bird. It commences singing about the middle of August, and so continues till the end of June. During a hard frost, when all other birds, including the Robin, are without song, the Dipper sings as merrily as in May.—E. A. Swainson (Woodside, Brecon).

A Question of interest in the Life of the Cuckoo.—The Cuckoo (*Cuculus canorus*), whose life is surrounded by so much of mystery, seems to be a perennial source of interest not less to the true bird-lover than to the casual observer. In view of possibly more attention being given to the habits of the Cuckoo during the coming summer, I am about to ask a question, and suggest an answer: Does the bird usually seen accompanying the Cuckoo migrate with it? Until I receive further information on the subject, I reply that it does not. On Aug. 22nd, 1894, I saw the interesting spectacle of a young Cuckoo, fully developed, attended by its foster-mother, a Meadow-Pipit. The "following" in this case was very decided, but I would put that down entirely to the maternal instinct. I can hardly think that a bird whose life is lived on such sober lines as the Meadow-Pipit would follow its foster-child far beyond the bounds of its favourite moorlands. It will rather, I think, give up its child, as other birds do, when the natural period of motherhood ceases. It is even less likely that the Cuckoo's dupe comes with it. This aspect of the question is, I think, hardly worth discussing; but, as throwing a little light upon the whole matter, I may record briefly an incident which came under my own observation on June 16th, 1903. I was spending an afternoon by the shore of the Solway, when my companion and I were attracted by the presence of two Cuckoos, male and female, among the rocks. One (the male) was calling; the other (the female) was attended by another bird, a Rock-Pipit. I have not hitherto seen the Rock-Pipit recorded as a dupe of the Cuckoo, but I am certain of its identity in this case. It was clear that the female Cuckoo was on the outlook for the nest of the Pipit. The latter did not follow closely, but when the Cuckoos arose on the wing it left its stance on a neighbouring rock, and took flight after them. The whole proceedings pointed to the fact that the dupe does not actually associate itself in any permanent way with the Cuckoo, but the Cuckoo, by a kind of hypnotism, secures a temporary influence over the dupe. Indeed, I would be inclined to say that the dupe actually leads the Cuckoo to its nest. If this assumption be proved correct, it fully accounts for the egg of the Cuckoo being, as it frequently is, laid in a nest of which discovery is next to impossible. I should add that I did not find the nest of that Rock-Pipit, but I feel pretty sure that the lady Cuckoo found it before the proceedings closed. J. W. Payne (1, Meadow Place, Edinburgh).

Little Owl (Athene noctua) and Waxwing (Ampelis garrulus) in Lincolnshire.—I have lately seen specimens of these birds, which were shot in this county. The Little Owl (a female) was shot on Jan. 11th last near Ruskington, Sleaford. It is rather a curious coincidence that two years ago, almost to the day, a bird of this species was obtained about nine miles from the same place (*cf.* Zool. 1902, p. 112). The Waxwing (a male) was shot at Brant Broughton on Jan. 8th. There were six of the wax-like tips on each wing. — F. L. BLATHWAYT (5, Monks Leys Terrace, Lincoln).

Lanner Falcon in Lancashire.—A specimen of the Lanner Falcon (*Falco feldeggi*) was picked up dead on the seashore near Carnforth, Lancashire, on April 26th, 1902. This bird, which is found in the countries bordering the Mediterranean, has never occurred in Great Britain before. The specimen is a female, not quite adult, but almost so. The wing measurement is 14·5 in., that of the male being 13·2 in. It was seen in the district for some weeks, during which time several men tried to shoot it, and eventually it was picked up dead by the owner, and almost warm, having a recent shot-wound beneath the wing. During its residence on the marsh it appeared to live upon small waders. I do not know whether this bird is used in falconry or no, but if any gentleman lost a Lanner Falcon in February or March, 1902, I shall be glad if he will mention the circumstance, so that the bird may not be classed as a truly British occurrence.—H. W. ROBINSON (Lansdowne House, Lancaster).

Great Skua (Stercorarius catarrhactes) in the Irish Sea.—It will no doubt interest Mr. P. Ralfe and other ornithologists to hear that on July 20th, 1903, both Mr. E. Williams, of Dublin, and myself had a splendid view of a Great Skua in Holyhead Harbour, not far from the landing-stage. We descried the bird, hotly pursuing a Lesser Black-backed Gull, as we stood on the deck of one of the cross-Channel steamers. This Skua is rarely seen in the Irish Sea, and a visit so close to shipping traffic seems somewhat unusual. Possibly this was the same bird that was taken at Douglas, Isle of Man, on a baited hook later in the season, as recorded by Mr. P. Ralfe (*ante*, p. 33).—C. J. PATTEN (University College, Sheffield).

Birds of Oxfordshire or Buckinghamshire?—I am glad to have been the means of bringing forward a champion for the somewhat neglected ornithology of Buckinghamshire. In recording, as I have for many years, the ornithological occurrences in Oxfordshire, I confess I have always declined to be bound strictly by a purely artificial boundary, especially as no one has of late years taken the trouble to record the occurrence of rare birds in that part of Bucks which adjoins Oxon, or, until recently, those in Berks. In this I had the support and approval of the late Mr. John Cordeaux, whose opinion on such matters I valued. If I knew exactly on which side of the political boundary the bird occurred, and it was outside our boundary, I said so; but I have seldom taken much trouble to ascertain this, as the question whether a bird fell dead, or was seen, on one side or the other of an artificial boundary line does not seem to me of much importance. It is the usual custom of recorders (not holding a brief for any particular county), when giving the locality of the occurrence of a rare bird, to mention the name of the nearest well-known place. And I entirely dissent on this account from Mr. Cocks's conclusion that the locality "near Reading" (in the case of a water-bird like the Purple Heron) must, in the absence of more precise locality, necessarily assign the bird as belonging to Berkshire. On whichever bank of the river it was killed, a recorder having no interest in championing, ornithologically, either county would give the name of the nearest important place as its locality. The fairer way is to treat the bird as belonging to both counties equally. But if one is to presume, or assume, the presumption is that this Heron would keep to the Oxfordshire bank of the river as much as possible, and as far from the manufacturing town of Reading as possible! I plead guilty to having, by a slip of the pen, written Berks for Bucks in two places. I fear that the fact that I wrote my paper only in the interests of Oxon (and that both Berks and Bucks, so closely interwoven ornithologically in one of the earliest county bird-books, were outside the object of that paper) may have occasioned me to overlook the mistake in the proofs. Woburn I spelt as it is written in the book from which I quoted. I assigned the village to neither Berks nor Bucks, nor did Clark-Kennedy, whose book applied to both. I do not quite understand if Mr. Cocks's remarks (top of p. 35) should apply to the Golden Oriole or the Ring-Ouzel.—O. V. Aplin (Bloxham, Oxon).

BATRACHIA.

Diseases of Salamanders.—About July last I bought two Spotted Salamanders, a male and female. Both appeared to be in perfect health and condition at the time of the purchase, the colours being very bright, and the action of the Salamanders being particularly quick. About three weeks after the purchase, however, I noticed that the colours of the male had become dull and faded, and on investigation I noticed that both its front feet had bad open wounds on them, as if they had been bitten at some time or other. I at once removed the creature from my vivarium, and put it into a smaller one alone. The next morning I found that similar sores had broken out on its tail, and also that the Salamander had suddenly become deplorably thin. That same afternoon it died. I then proceeded to thoroughly clean my vivarium, and closely examined all my Reptiles and Amphibia, which I found to be in apparently perfect condition. A week later I discovered, to my dismay, that the female Salamander had been affected in the same way as its mate, only not quite so bad. Only the left fore foot showed an open wound. This time I decided to wash the wound with disinfectants and keep it bandaged up. Apparently the wound began to heal, and the colours of the Salamander again became vivid; but as the days slipped on I noticed a decided shrinkage in the proportions of the poor creature, and soon the back legs also began to rot away, and it was not long before my second Salamander was dead. If any of your readers could tell me from what disease my Salamanders suffered, and what might have been the cause of same, I should feel very thankful. All my reptiles are still in the best of health, and never before have I had any serious trouble with any of my Salamanders. I found an ants' nest in the vivarium, and at first put it down to the ants, but I found that they did not like to touch the Salamanders—in fact, they avoided them whenever they could; so evidently the sores were not produced from the effects of the formic acid of the ants.—H. E. Mussett (Thornwald, 249, London Road, West Croydon).

[Mr. Boulenger informs me that he has had similar experiences with Salamanders in captivity. The cause of the disease is still obscure.—Ed.]

PISCES.

The Red Snake-Fish (Cepola rubescens, Linn.) in Dorset.—Though not precisely a very rare fish, the capture of the Red Snake, or Band-fish, is of sufficiently uncommon occurrence to merit a passing notice. Neither is it a fish that is likely to be overlooked, for its large staring eyes, underhung bull-dog-like mouth, comparatively large head, and thin riband-like body, render it, when gliding through the water in snake-like undulations, by no means an attractive creature. The oldest fisherman had never seen the like, and his daughter declared that it must be a mermaid. Scarcely a compliment, but uttered doubtless through jealousy. *C. rubescens*, so called on account of its bright orange-red hue, is a denizen of the deep sea, coming inshore occasionally in pursuit of the Sprat, and sometimes finding itself enfolded in the meshes of the nets cast for these fish. The present example, not quite twenty-two inches long, was taken in a Sprat-net off the mouth of Poole Harbour, Dorset, in January, and constitutes a new record for that county.—Fredk. Pickard-Cambridge (Wimbledon).

OBITUARY.

Dr. William Francis.

The death of Dr. Francis, which occurred on the 19th January, will be regretted by all zoologists, to most of whom 'The Annals and Magazine of Natural History' is one of our best known publications. He was born in London on Feb. 16th, 1817; educated for a time at University College School, but chiefly at St. Omer, Cravelt, and Gera, which he left in 1836, and spent a short time at the London University (University College). Thence he went to Berlin, and subsequently to Giessen, where he took his degree of Doctor of Philosophy in 1842.

In 1837 he suggested to Mr. Taylor the establishment of the 'Annals,' which he edited from the commencement, although his name did not appear on the wrapper until January, 1859. He became co-editor of the 'Philosophical Magazine' in 1851, but for a long time previous had taken an active share in its management. In 1842, in conjunction with Henry Croft, he founded the 'Chemical Gazette.'

During his long life Dr. Francis, in his business capacity, printed a vast number of zoological books and publications, was in touch, as editor of the 'Annals and Magazine,' with most zoologists, and proved what the printing press at Red Lion Court could do in the furtherance of biology. In his business establishment it was always a pleasure to see the same old official faces, a criterion of the qualities of both employer and employée, and he may truly be said to have enjoyed the respect of all with whom he was brought in contact. Before his declining years he used annually to entertain a company of entomologists and other zoologists at his Richmond home.

NOTICES OF NEW BOOKS.

Fatigue. By A. Mosso. Translated by Margaret and W. B. Drummond. Swan Sonnenschein & Co., Ltd.

In all animal life, in all mental effort, fatigue is a dominant factor; it affects the brain of the thinker as much as the muscles of the athlete, but is such a familiar phenomenon as to be seldom studied, and usually regarded as a limitation to be received with submission and endured with wisdom. Professor Mosso, of Turin, whose work on "Fear" is already known in the English language, has published a study on animal fatigue, and this book is a translation of the same, of which the author has revised the proof-sheets.

Migratory birds suffer much from fatigue. The Quail, which we read "flies nearly nineteen yards per second, or thirty-eight miles per hour," frequently crosses the Mediterranean in favourable weather without great fatigue, though Brehm has described the arrival of a crowd of them on the north coast of Africa "nearly dead with fatigue." De Filippi has seen Pigeons in the open sea, and in a similar condition, "resting on the waves with outspread wings." Prof. Mosso applies this weariness of the Quail to illustrate a point in the Biblical narrative of Exodus, where the Hebrews are described as fed on Quails in the desert. "The ease with which they let themselves be caught shows how much they were exhausted by their journey." Our author has also experimented on and observed the effects of fatigue on Carrier-Pigeons (long-journey birds). The younger birds arrived at the end of their journey subsequent to the appearance of the older ones, and it "was easily seen that they were very tired, for they alighted on the roof and remained motionless, while the old birds, which had made the same journey, were lively, and kept flying round in great circles and cooing. . . . This shows that their instinct is not of much use to them, if they are not trained."

Some interesting facts are given of the life and career of

Borelli, who wrote 'De Motu Animalium' more than two centuries ago, a work which Mosso considers "modern physiologists should still consult and study." Borelli challenged the then orthodox conception of the will, and was reproached by the Abbé Antonio Rosmini with confusing the sensitive principle with the reasonable soul, and who affirmed that in this doctrine "one may see the origin of modern materialism." Nevertheless, Borelli, the animal physiologist, wrote his book in a monastery, and died in a convent cell; his tomb is in the Church of Saint Pantaleo in Rome, and the inscription ends with the words: "HEIC ADMIRANDUM DE MOTU ANIMALIUM OPUS ABSOLVIT SIMUL CUM VITA."

The larger part of this book is devoted to the mental fatigue frequently experienced by scientific men, though frequently conquered in triumph, as was the case with Darwin, of whom a most generous and competent admiration is expressed throughout the pages. This book is of physiological importance, of great zoological interest, and is worth the perusal of lecturers and teachers.

BRITISH 19 MR 1904 MUSEUM